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KNOCK SENSOR FOR AN INTERNAL COMBUSTION ENGINE

The invention pertains to a knock sensor for an internal combustion engine with an electronically evaluated vibration sensor. The vibration sensor of known knock sensors is realized, for example, in the form of a piezoceramic element.

Knock sensors of this type are known, for example, from EP 0 47 22 19 B1, EP 0 844 470 B1 and DE 195 39 919 C2.

The invention is based on the objective of realizing an electronically evaluated vibration sensor of this type such that it has a simpler design and can be applied within a knock sensor more rationally than up to now. In addition, the transmission of the measuring signals should be simplified.

To this end, the corresponding vibration sensor is primarily realized in the form of a piezoresistive amorphous carbon layer that is rigidly applied onto a surface section of a base body and may consist, in particular, of a DLC (Diamond Like Carbon) layer. Such layers and their application, for example, by means of a PVD (Physical Vapor Deposition) or CVD (Chemical Vapor Deposition) method, as well as sensors that are made from such layers and used for determining parameter values of mechanical components, are described in DE 199 54 164 A1. Washers that are provided with measuring layers and used for controlling non-positive connections are also known from DE 19 831 372 A1.

Practical embodiments of the knock sensor according to the invention form the objects of the dependent claims. Accordingly, a spring washer that is conventionally provided in knock sensors as a tensioning means may serve, in particular, as the base body, onto which the measuring layer is applied.

The invention essentially proposes to eliminate, in comparison with the current state of the art, an additional component that usually consists of the vibration sensor in a knock sensor of this type, namely by directly applying a thin measuring layer onto the surface of a component that not only fulfills the vibration sensor function. It is particularly advantageous to apply the measuring layer onto a tensioning element in the form of the spring washer provided in the knock sensor. The spring washer may be realized, in particular, in such a way that the seismic mass of the knock sensor that is usually braced within the knock sensor by means of a spring washer is an integral part of the spring washer.

In the piezoresistive amorphous carbon layers to be utilized in accordance with the invention, the vibrations of the internal combustion engine cause voltage changes in the layer, for example, when said vibrations act upon the spring washer, wherein these voltage changes can be conventionally evaluated. When utilizing a spring washer with a piezoresistive amorphous carbon layer, the deformation of the spring washer is used for generating electrically measurable voltage changes in the layer.

Pressure load changes in a piezoresistive amorphous carbon layer can be evaluated without utilizing a spring washer if said layer is arranged between a seismic mass and an abutment for the seismic mass that is rigidly connected to the internal combustion engine.

The high measuring sensitivity of the measuring layer according to the invention is particularly well suited for a telemetric signal evaluation. With respect to the principle of telemetric signal evaluation methods to be considered for this purpose, we refer to the state of the art, for example, according to DE 40 34 019 C1, EP 0 533 709 B1 and DE 37 14 195 A1.

Advantageous and practical embodiments of the invention are illustrated in the figures.

The figures respectively show in the form of a longitudinal section:

Figure 1, a first embodiment of a knock sensor with a spring washer arranged between a seismic mass and an abutment that can be rigidly mounted on an internal combustion engine;

Figure 2, a knock sensor according to Figure 1 with a washer or spring washer in the planar state according to Figure 1;

Figure 3, a knock sensor with a DLC layer between a seismic mass and an abutment that can be rigidly mounted on an internal combustion engine;

Figure 4, a knock sensor with a seismic mass that is tensioned with the aid of a screw, wherein the DLC layers are situated on the underside of the screw head and on the mounting body;

Figure 5, a knock sensor according to Figure 1 with a spring washer that is tensioned to a defined value by means of a special screw;

Figure 6, a knock sensor with a spring washer and a special screw that serves for tensioning the spring washer and can be directly screwed to the internal combustion engine, and

Figure 7, a knock sensor with a seismic mass clamped between two spring washers.

The knock sensor according to Figure 1 comprises a mounting body 1 for being rigidly screwed to the casing of an internal combustion engine and a screw 2 that is anchored in the mounting body 1. The head of this screw clamps a seismic mass 3 against the mounting body 1 via a spring washer 4 arranged in between.

The face of the spring washer 4 that points to the head of the screw 2 is sectionally provided with a piezoresistive amorphous carbon layer in the form of a DLC layer. Electric lines 6 lead from this layer to an electronic evaluation unit that is not shown in the figures. The thickness of the layer preferably lies in the range between 1 and 10 µm.

If knocking of the internal combustion engine occurs, the seismic mass 3 realized in the form of an annular part is acted upon by the spring washer 4 and thusly stimulated. This causes the seismic mass to exert a corresponding load upon the spring washer 4 such that a corresponding voltage change occurs in the DLC layer 5 applied onto the spring washer 4. This voltage change is transmitted to an evaluation electronic via the electric lines 6 and evaluated therein. In order to realize a telemetric transmission, the measuring signals originating from the layer 5 can be transmitted by means of a transponder that is arranged on the component in question together with the DLC layer 5. Conventional transmission cables and their connecting means can be eliminated by utilizing this customary transmission principle.

In the embodiment according to Figure 2, the spring washer is replaced with a washer 7 that may also consist, if so required, of a flatly clamped spring washer 4.

It would also be conceivable, in principle, to apply a DLC layer 5 onto both sides of the spring washer 4 or the washer 7, respectively.

When using the washer 7, the electronically evaluated voltages are generated in the DLC layer 8 by essentially tangential tensile and/or compressive stresses within the washer 7.

The embodiment according to Figure 3 contains neither a spring washer nor a washer 7, but rather a DLC layer 8 that is arranged directly between the seismic mass 3 and the mounting body 1. The vibrations are sensed in the form of compressive stress changes within the DLC layer 8.

In the embodiment according to Figure 4, DLC layers 9, 10 are provided on the seismic mass 3 on both opposing clamping regions, wherein said layers are rigidly connected to the mounting body 1 on one hand and to the head of the screw 2 on the other hand.

Figure 5 shows a knock sensor, in which a special screw 11 is used for tensioning the spring washer 4. A stop collar 12 that is integrated into the screw 11 makes it possible to easily adjust a defined tension of the spring washer 4 with the aid of this special screw.

When utilizing such a special screw 11, a corresponding screw-on mounting body can be eliminated as shown in Figure 6.

In the embodiment according to Figure 7, a seismic mass 3′ is clamped between two spring washers 4, 4′. If still required at all, the seismic mass can be considerably reduced in this embodiment.

All knock sensors shown are provided with a cover housing 13.